Rice University
Civil and Environmental Engineering

CEVE 420/520 – ENVIRONMENTAL REMEDIATION AND RESTORATION

SPRING 2020 Syllabus

Course objective

The objective of this class is to provide you with the knowledge of the processes, chemicals, technologies, and institutional considerations that you need to select an appropriate method for cleaning up contaminated soil, groundwater, sediment, and surface water that has become adversely impacted by chemicals.

Textbooks

Practical Design Calculations for Groundwater and Soil Remediation, Second Edition by Jeff Kuo, CRC Press; June 2, 2014, ISBN-10: 1466585234.

I will also give you technical papers, other book extracts, and reading assignments from time to time. We will make extensive use of internet resources. I will include the relevant internet links in the lecture notes. Lecture slides will be usually be distributed before each lecture in hard copy, and all lectures will be posted to Canvas.

Grading

Exams (2)	40%
Homework	20%
Group Report	20%
Final (comprehensive)	20%

Exams

Two closed-book exams will be given in class. The first exam is tentatively scheduled for February 13, and the second is tentatively scheduled for March 31. Both exams will be mostly qualitative with short answers to test your knowledge of specific issues and your understanding of key concepts. There will also be some brief quantitative exam questions to make sure that you know how to apply some of the principles taught.

The final exam will be comprehensive plus new material and similar to the earlier exams.

Homework

Homework assignments will generally be due 1 to 2 weeks after distribution. Assignments and solutions will be posted on Canvas. Grades on late homework assignments will be reduced by 10 percent of the possible homework grade for each day or part of day that they are late. Homeworks focus on quantitative calculations typical of remediation projects. Extensions can be given *with prior arrangement*.

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Group Report

Each student team will prepare a design report on a key topic covered in the class. The report will consist of a conceptual design of a site remediation project. Key elements of the report will include:

- A background section explaining the issue and technical approach;
- How cleanup levels were established;
- A description of the technology selection process;
- A detailed description of the selected technology;
- A preliminary conceptual design, in the form of text and rough drawings, that illustrate the major design components;
- Calculations to support estimates of materials, labor, and capital needs as well as technical performance;
- A preliminary cost estimate and schedule.

Field trip to Industrial Site

We will take a field trip to an industrial site to see monitoring wells and see active groundwater extraction systems, time permitting. The trip is tentatively scheduled for March 26, but it could be moved earlier or later depending on the weather and class activities.

Instructor and Office Hours

Phillip C. de Blanc, Ph.D., P.E.
Lecturer in Civil and Environmental Engineering
107 Mech Lab
Phone: 713-348-4725
Mobile: 281-635-6069 (Emergencies only please!)
Email: pcdeblanc@rice.edu

Office hours by appointment.

I check email regularly, and you are encouraged to communicate by email whenever possible. I will usually respond within a few hours, but never more than 24 hours later (except on weekends and holidays).

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1. Introduction - Why clean up the environment?
2. Overview of environmental contamination
    a. Sources and Extent of Chemical Contamination in the U.S. and World
    b. Types of sites
    c. Types of Media Affected with examples
    d. Classes of chemical contaminants
    e. Physical nature of contaminants (dissolved, NAPLs, etc.)
3. Site Investigation
    a. Objectives – ID nature, magnitude, and extent of impacts
    b. Conceptual model
    c. Preliminary assessment
    d. Field investigation techniques
    e. Field testing techniques (slug tests, pumping tests, tracer tests)
    f. Laboratory analyses
    g. Assessing extent of impacted media (interpolation techniques, etc.)
4. Risk Assessment
    a. Fundamentals – dose, pathways
    b. Carcinogenic and non-carcinogenic risk considerations
    c. Forward calculations – determining risk from a site.
    d. Backward calculations – calculating cleanup levels
    e. Statistical methods for cleanup
5. Chemical and Physical Properties Affecting Remediation Technologies
    a. Media Characteristics
    b. Chemical Characteristics
    c. Institutional
6. Remediation objectives and classification of technologies
    a. Remediation Objectives
    b. Classification of Remediation Technologies
7. Technologies for Soil Remediation
8. Technologies for Groundwater Remediation
    a. Groundwater extraction
    b. Ex-situ groundwater treatment
    c. In-situ groundwater treatment
    d. Containment
9. Selection of remedial alternatives
    a. Sources of information on remediation technologies
    b. Factors to consider
    c. Presumptive remedies
    d. Technology evaluation
    e. Assembling technologies into complete alternatives
    f. Criteria for evaluation of alternatives
10. Remediation Design Elements
    a. Treatability testing
    b. Supplementary investigations
    c. Design
    d. Use of models
    e. Cost Optimization
    f. Long-term monitoring/sustainability

11. River and Sediment Remediation and Restoration
    a. Surface water
    b. Sediments
    c. Case studies

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Day	Date	Week	Class	Subject
Tue	14-Jan	1	1	First Day of Class Introduction
Thu	16-Jan	1	2	Contaminants/Site Investigations
Tue	21-Jan	2	3	Risk Assessment
Thu	23-Jan	2	4	Chemical, Physical Properties
Tue	28-Jan	3	5	Soil remediation
Thu	30-Jan	3	6	Classes of remediation technologies Guest Lecture - Risk Assessment
Tue	4-Feb	4	7	Soil remediation technologies
Thu	6-Feb	4	8	Soil remediation technologies
Tue	11-Feb	5	9	Soil remediation technologies
Thu	***13-Feb***	***5***		***Spring Recess - No Class***
Tue	18-Feb	6	10	Focus: soil vapor extraction Guest Lecture: SVE Design
Thu	20-Feb	6	11	Groundwater remediation
Tue	***25-Feb***	***7***	***12***	***Exam No. 1***
Thu	27-Feb	7	13	Groundwater remediation technologies
Tue	3-Mar	8	14	Groundwater remediation technologies
Thu	5-Mar	8	15	Groundwater remediation technologies
Tue	10-Mar	9	16	Focus: engineered bioremediation Guest Lecture – In-Situ Bio Design

Day	Date	Week	Class	Subject
Thu	12-Mar	9	17	Selection of remedial technologies
Tue	***17-Mar***	***10***		***Spring Break - no class***
Thu	***19-Mar***	***10***		***Spring Break - no class***
Tue	24-Mar	11	18	Remediation design elements
Thu	26-Mar	11	19	Field Trip
Tue	***31-Mar***	***12***	***20***	***Exam No. 2***
Thu	2-Apr	12	21	Surface water resources
Tue	7-Apr	13	22	Surface Water/Sediments
Thu	9-Apr	13	23	River restoration
Tue	14-Apr	14	24	River restoration
Thu	16-Apr	14	25	Low impact development
Tue	21-Apr	15	26	Low impact development
Thu	23-Apr	15	27	Last day of class (open)
Sat	25-Apr			Start of study period
Wed	29-Apr			First day of finals
Wed	6-May			Last day of finals
Fri	8-May			Grades due